A Study on Curriculum Development in Vocational Technical Education for Development of Flexibility and Trainability of the Workforce

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Introduction

Comparing vocational technical education and training in western countries and in Japan, we find both similarities and differences.

The similarities are the acceleration of change in the industrial sector and the platitude/prevalence of industrial technique. We have been expected to deliberate on Vocational Technical Education (VOTEC) from the viewpoints of quantity and quality of workforce. The different points are caused by different policy measures and socio-economic, cultural background in both countries. Dr.J.K. Lee summarised the relation between educational institutions and industry as shown in Fig 1. (Lee, J.K.1985)

This paper describes how to adjust VOTEC to changing workplaces through development of flexibility and trainability in school education. In recent years, Japanese industrial and educational practice has attracted worldwide attention. (Prais, S.1987, Ronald P, Dore & Mari Sako 1989, Keith Drake 1991,) Observers (Sam Stern.1991) mentioned that the human resource development in Japan was characterized as "School Based Education and On the Job Training (OJT)" in the workplace.

Concerning the process of development of VOTEC, we have to consider the present educational, economic, social and cultural conditions in each country: in particular, we must look at general and vocational education in schools, training in institutions and industry, job offer-employment system and wage systems.

1 Curriculum in Transition

In Japan, curricula for elementary, lower secondary, and upper secondary are promulgated by the M.O.E. Curriculum Standard the "**Course of Study.**" ("Gakusyu-Shidoyoryo") It is revised at all levels about every ten years. Revision of subject matters is made by subcommittees of the Council for Curricula. The members appointed by M.O.E. are curriculum specialists, professors of teachers colleges, classroom teachers, and local members of the board of education ("Kyoiku-Iinkai").

The development process of technological education can be divided into four eras according to Japan's economic circumstances: the Economic Reconstruction Era, the High

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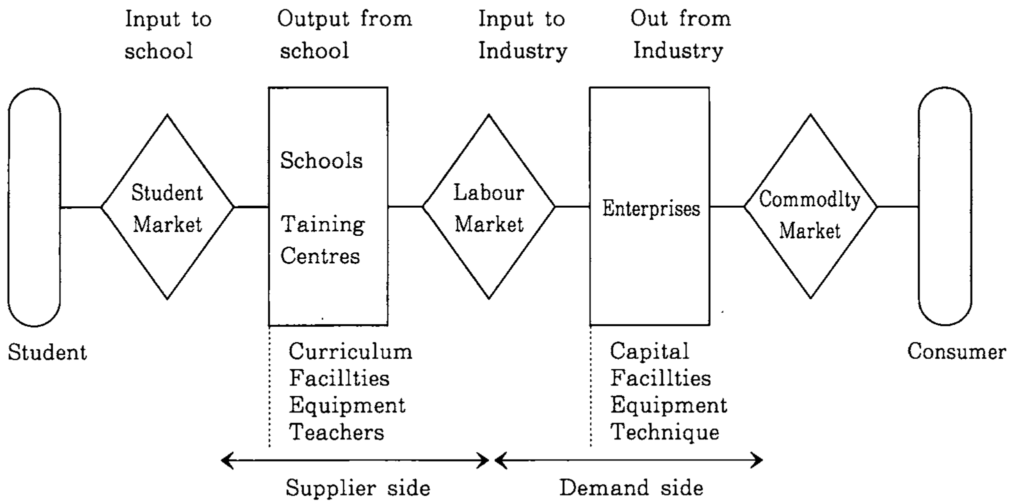


Fig 1　Relation between school and industry in VOTEC (by J, K, Lee)

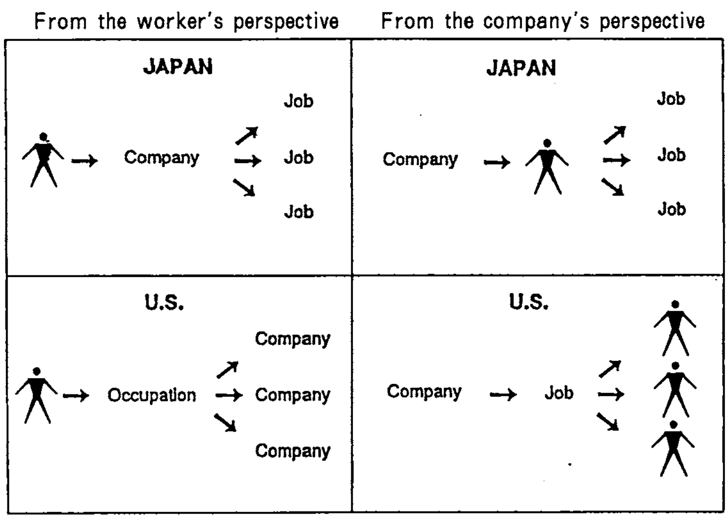


Fig 2　Perspectives on Work and Employment in the US and Japan (by Stern, S)

Economic Growth Era, the Stabilized Economy Era and the Internationalized Economy Era. (Murata, S.1990) (Table 1)

(1) Starting of Vocational Technical Education as a Required Subject

After World War II, the Japanese economy was seriously disoriented. The Japanese government tried to reconstruct her industry in various ways under the leadership of General Head Quarter (G.H.Q.) of the United Nations, which aimed to implement a policy of democratization of the economy and education.

In the Economic Reconstruction Era, about a half of lower secondary school's

Table 1 Economic Development and Educational Policy

	Socio-Economic Conditons	Enrollment Percentage			New Educational Policies (Vocational-Technical Education)
		Upper Secondary	College/ University	Post Sec. Train.Inst.	
Economic Recon-struction Era	Shortage of food. houses etc Conclusion of Peace Treaty 5-year economic plan "Sputnik" launched	43.0% ('50) 51.5 ('55)	10.1 ('55)		·Democratization of Education ·Introduction of the 6-3-3-4 new school system (1947) ·Vocational Education Promotion Law (1951) ·Allowance Payment for technical teachers (1957) ·Vocational Training Law (1958)
High Economic Growth Era	Promotion of science & technology Doubling of National Economy Program High Economic Growrth (about 10%) yearly Enviromental pollution	57.7 ('60) 70.7 ('65) 82.1	10.3 ('60) 17.1 ('65) 24.0		·Introduction of Industrial Arts (1958) ·Doubling of the number of technical schools ·Establishment of Technical College (post L.S.Sch. 5 year system · Diversification of technical-vocational education (1968) ·Introduction of Natural Science Course (1968) ·Revision of Vocational Training Law (1969) ·Introduction of information related subjects in Technical High Schools (1978)
Stabilized Economy Era	Oil crisis ('71.'74.) Slowdown of economic growth Stabilized economic growth (3-5%)	91.9 ('75) 94.0 ('80)	34.2 ('75) 31.9 ('80)	14.6 ('76) 20.2 ('80)	·Establishment of Special Training Schools (Advanced course 1976) ·Introduction of Fundamental subjects for Technical Schools (eg. Fundamentals of industry. Industrial Mathematics) (1978) ·Introduction of Work Experience Activities for General Course
Internation-alization Economy Era	Popularity of micro-electronics & service industry Internationalization of economy Economic friction and cooperation	94.1 ('85) 95.1 ('90)	30.5 ('85) 30.6 ('90)	24.7 ('85) 29.7 ('90)	· Introsuction of foundamental courses for Mechatronics, and Service Economy, (1985) -Human Resource Development Law (1985) ·Introduction of Foundamental of Information Technology in Lower Secondary Schools, Independent Study Project, Information Technology-related Subjects for all Vocational Course in Upper secondary schools (1989) · Life-long Integrated Education and Training

graduates started to work just after their granduation, and vocational subjects were required for all boys and girls. The Course of Study concerning vocational education was comprised of five groups of subject matter: agriculture-related, industry-related, business-related, fishery-related, and home economics-related. The curriculum was not systematic, but much too diversified and region oriented in both lower/upper secondary schools. Vocational subjects in lower secondary schools aimed to foster student's consciousness of career through try-out/experience.

(2) Introduction of Industrial Arts

In 1957, the Soviet Union launched a satellite called "SPUTNIKU". After this event, most of the developed countries tried to improve their science and technology education. At the end of 1957, the Japanese government adopted policies for the promotion of science and technology in accordance with recommendations made by the Central Educational Council. M.O.E. introduced Industrial Arts ("Gijutsu-ka" gijutsu means technology, ka means subject) to lower secondary schools as a required subject in 1958, and in 1960 set out to double the number of technical high schools. In this era, 5-year technical colleges were established for students who finish compulsory education. In order to cope with a shortage of technical teachers, the Japanese govement established three-year teacher's college for technical education. These colleges were attached to the faculties of technology at national universities and enrolled about 900 students every year in the 60's. These policies were related to the Doubling National Income Program ("Shotoku-Baizo-Keikaku"). At the beginning of this era, M.O.E dispatched a curriculum specialist in charge of technical education to the U.S.A. in order to introduce technology-related subjects. (Suzuki, H 1990)

In 1962, M.O.E. established Industrial Arts ("Gijutsu-ka"). As shown in table 2, the objectives of induatrial arts in Japan are undoubtedly industry-based and technology-oriented. The focus of curriculum shifted from diversified traditional vocational subject matters to technology-oriented contents.

Contents of Home Economics ("Katei-ka") also included technology-related subject matters such as Design and Drawing (15 school hours), Home Craft (30), Home Machinery (40), and Home Electronics (20). The time allocated for technology-related subject matter is one third of all teaching hours for Home Economic. (M.O.E.1958) In this era, Science and Mathematics Course ("Risu-ka") was also established in upper secondary school. And in 1970, information related subcourse was established in industry-related course and business-related course in upper secondary schools. As shown in table 3, there are hardware-oriented Information Technology Course ("Jyoho Gijutsu-ka") for technology education and software oriented Information Processing Course ("Jyoho Shori-ka") for business education. These courses were introduced, following recommendations by the Council for Science and Industry Education (1969), and the Committee for Information Processing Education (1972).

Table 2 A Summary of Objectives and Contents of I.A. Curriculum in Japan

Objectives	Contents	Time Allocation		
		7th	8th	9th
1. To help student to train basic skills, through creative / productive experience, to understand modern technology and foster fundamental attitudes for practice.	· Design and Drawing · Pictorial Drawing, Orthogonal Projection, Blueprint Reading and Planning	25,	30,	
	· Wood Working, Metal Working Sheet Wood, Sheet Metal Rectangular Wood, Bar Metal, With Tool /Machine	60,	55,	
2. Through experience of design and realization, to foster skills for presentation, creation and rational attitudes for problem solving.	· Machinery Mechanics of Home / Production Machine, Prime Mover		20,	25,
	· Electricity Circuit, Home Electronics Telecommunication Device			45,
3. Through experience of manufacturing/operation of machine/device, to understand relation between technology and life, and to foster attitudes for improving technology and daily life.	· Cultivation Flower Raising, Food Plant Raising	20,		
	· Integrated Practice e.g.Agricultural Machine, Wood-Metal Construction			35,
		Total Hours 105,	105,	105,

Table 3 A Summary of Objectives and Contents of Information Related Subjects in Upper Secondary Schools

Objectives	Contents
◎ Information Technology Through practice, to understand fundamental knowledge and to train skills concerning information processing, management and manufacturing, and to foster attitude for application and creation. To understand methods of programming, and construction of computers.	· Manufacture of Machine · Measurement through Electric Device · Experiment about Materials · Automatic Control of Machine and Device · Programming for Control · Programming for Manufacturing · Dater Processing from Basic Information Processing to Complicated Information Processing
◎ Information Processing Through practice, to understand fundamental knowledge and to train skills concerning information processing, management and business. To train basic skills for programming, and to foster attitudes for rational implemention of business.	· Function of a Computer · Input/Output of Data · Programming · Data Processing · Hardwere and Software · Basic/Simple I.Processing · Methodology of Programming · Information and Management · Information Processing for Selling, Buying and Accounting

(3) Introduction of Fundamental Subjects and Equal Opportunity in Education

Through the High Economic Growth Era, the percentage of enrollment in upper secondary schools and in higher educational institutions increased. In 1975, the number of lower secondary school graduates who advanced upper secondary education exceeded well over 90%, which virtually made upper secondary education equivalent of compulsory education (Table 4). However, such increases in the number of student advancing to upper secondary schools caused labour shortages in manufacturing sectors, which had long depended solely on lower secondary graduates. Because of the new demand for labour force the manufacturing sector began to employ upper secondary graduates (Table 6) (Fig 4).

From the viewpoint of preparing students for the world of work in Japan, upper secondary school education faces the following problems;

① general courses are regarded as more important, while VOTEC has not been sufficiently strengthened;

② upper sccondary school education has been strongly oriented towards the preparation of entrance examinations, causing still further neglect of VOTEC.

On the other hand, knowledge and skills for the work place changed dramatically. In industry-related sectors, employers began to expect workers to have flexible and trainable competency. M.O.E. introduced fundametal subjects to vocational technical courses and also introduced Work Experience Activities ("Kinrou-Taiken-Gakusyu") to general courses.

In this era, in the secondary school level, problems on equal opportunity in education emerged. Until then Industrial Arts had been presented for mainly boy students and Home Economics for girl students. In order to give equal opportunity, M.O.E. revised the Course of Study. Since 1977, all boys have been required to take one class of Home Economics,

Table 4 Employment/Education Choice of Lower Secondary School Granduates

Total of Males and Females (persons, %)

Division	① Total	② Those entering upper secondary schools, etc.	③ Those entering special training schools and miscellaneous schools	④ Those entering public vocational training facilitles, etc.	⑤ Those who found employment	⑥ Others	Rate of those entering higher schools ②÷①	Rate of those who found employment ⑤÷①
1955	1,663,184	857,032	–	–	698,007	172,576	51.5	42.0
1960	1,770,483	1,022,424	–	–	683,697	114,835	57.7	38.6
1965	2,359,558	1,667,080	–	–	624,731	143,803	70.7	26.5
1970	1,667,064	1,368,898	–	–	271,266	83,992	82.1	16.3
1975	1,580,495	1,453,165	–	–	93,984	64,118	91.9	5.9
1980	1,723,025	1,623,759	26,303	16,574	67,417	11,989	94.2	3.9
1985	1,882,034	1,771,164	31,275	12,506	70,527	16,807	94.1	3.7
1986	1,933,616	1,821,405	34,667	11,495	68,723	17,625	94.2	3.6
1987	2,005,425	1,890,559	38,973	10,348	62,645	19,549	94.3	3.1
1988	2,044,923	1,933,055	38,714	9,359	61,685	19,180	94.5	3.0
1989	2,049,471	1,941,320	37,419	8,719	59,461	18,948	94.7	2.9
1990	1,981,503	1,884,183	32,671	7,496	54,822	17,258	95.1	2.8
1991	1,860,300	1,774,056	34,874	6,757	48,001	15,359	95.4	2.6

Source: "Basic Survey on Schools"

Note 1. "Others" mean jobiess persons, the deceased and those for whom information is not clear.

2. The figures do not include those who studied in special courses.

3. "Those who found employment" include those who both found employment and entered higher grade schools.

Table 5 Overview Technical and Vocational Education in Japan

Level	Subject (S.), Courses (C.)	Area, Content	Hrs/week, Credit	Remarks [ ] Goal
Primary Scool	S. Painting & Handicraft	Paper, Bamboo, Wood, Clay and Wire	1 st- 6 th grade 2 hrs/weeek	Primary Science Studies include simple mechanical toys Fundamental Circuit, Kinds of Energy
Lower Secondary School	S. Technological Studies and Home-Making	* Woodwork (includes Drawing), * Home Life, * Electronics, * Food/Neutrition, Housing Metalwork, Machinery, Cultivation, Childcare, Foundation of Information	7 - 8 th grade 2 hrs/wk. 9 th grade 2 - 3 hrs/wk. * Required for all, others Required Elective	Secondary Mathematics, Natural Sciences, both subjects are required. Technological Studies and Homemaking required for all boy and girl students
Upper Secondary School	C. Related Course in Agriculture, Industry, Business, Fishery, Home Economics, Nursing	Cultication, Livestock, Forestry, Fruit Trees Machinery, Electronics, Mechatronics, Civil Eng'g. Information Eng'g, Chemical Eng'g Information Processing, International Economy, Fisheries Eng'g, Fishing Boats, etc.	Voc.S. Required over 30 cred (40-50 credits on avg) Complete School Requirement over 80 credits (about 90-100 credits avg)	Each course established fundamental required subjects such as "Fundation of In dustry" " Foundation of Information Technology "National Local Certificate Diploma. About 26% students enrolled in Vocational C. s, [Middl class technical workers]
Vocational Training Center	C. Initial Tr. (Ordinary C. Special Tr. C.-college level-) Upgrading Tr.	Drawing, Machine Tool, Electricity, Welding Metal Working, N.C.Machine Operation Design. Mechatoronics. Productive system.	Or.C 2 yrs, After L.sec.sch./ 1 year After Upp.sec.sch. Sp 2 yrs, After Upp.sec.sch.	The institute belongs to Ministry of Labour [Semiskilled / Skilled Worker], (7000/yr) Sp.Tr.C. [Technical worker/ Technician] (2000/yr)
Special Training School	C. High school level (after finising low. sec) College level (after finishing up. sec), General Course (no restriction)	Culture/liberal arts related, Business, Medical, Home Economics, Education Welfare, Indusrtry (eg. Civil Eng'g Electronics, Information, Architecture,) Hygiene (Cooking, beauty culture) Welfare,	Advance course College level 2 yrs, Preparation entrance examination 1 year, Medical related 3 yrs,	By the amendments of Sch. Ed. Law, these youth included as legal students in article 82, who didn't advance to up. sec. sch./college/univ.or adults reentering sch. [Semi-skilled worker/Technical worker/ Technician] secondary course advance courses
Technical College	C. Machinery, Electronics, Civil Engineering, Aero-Eng'g, Marine Eng'g Architecture,	Drawing, Mechanics, Strength of Materials, Industrial Mathematics, Hydroynamics, Thermodymamics, Electronics, Machine Design, Information Technology,	10-14th grade (after graduate low. sec.sch.to college graduate level)	Mostly technician courses. Some of them advance to department of Engineer of universities. [Technician]
University Graduate School	Faculty of Agri, Business, Engineering, Management, Master Course, Dr.Course	Thermodymamics, Electronics, Bio-tehnology, Information Technology, Hydrodynamics, System Engineering, Management Technology	4 yrs under graduate 2 yrs Master Course 3 yrs Doctor Course	[Specialist, Manager, Engineer] [Technologist, Scientist]

Fig 3 Distribution of Newly Graduated Employeers by School Career

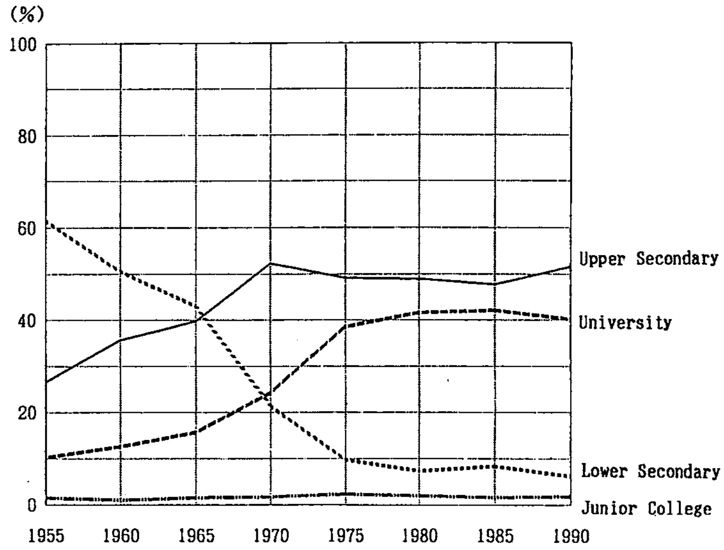


Table 6 Occupational Distribution (percentage) of Upper Secondary School Graduates (who found employment immediately after graduation)

Division	1955			1970			1980			1990		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total	100.0 (340,529)	100.0 (224,679)	100.0 (115,850)	100.0 (816,716)	100.0 (395,989)	100.0 (420,727)	100.0 (599,693)	100.0 (280,585)	100.0 (319,108)	100.0 (622,330)	100.0 (301,738)	100.0 (320,592)
Professional and technical fields	5.9	7.5	2.8	2.7	2.6	2.8	3.4	3.0	3.8	4.0	5.1	3.0
Clerical work	33.5	24.8	50.4	34.3	13.0	54.3	34.1	11.0	54.3	28.2	9.6	45.7
Sales	15.2	14.4	16.6	17.0	15.6	18.3	17.8	17.6	17.9	17.0	14.3	19.6
Agriulture, forestry and fishing	17.6	20.4	12.4	3.7	6.3	1.2	1.8	3.3	0.3	0.2	0.5	0.05
Mining	0.6	0.9	0.0	0.1	0.1	0.0	0.0	0.1	0.0	—	—	—
Transport and communications	1.5	2.0	0.4	3.1	5.0	1.3	2.5	4.7	0.6	1.7	2.8	0.7
Skilled work, production process work, and general labor	16.4	22.1	5.6	31.9	49.3	15.6	28.8	46.8	12.9	34.0	54.3	15.8
Security	4.7	3.7	6.4	5.6	3.4	5.3	2.9	5.9	0.3	2.1	3.8	0.4
Services							7.6	5.8	9.2	11.3	8.4	14.0
Others	3.9	3.5	4.7	1.6	2.0	1.2	1.2	1.7	0.7	1.2	1.7	0.8

Source: Ministry of Education, "Basic Survey on Schools"

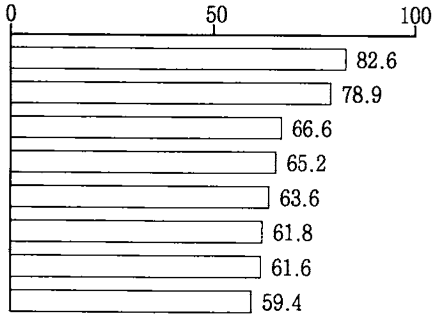
Note: The bracketed figure in the lower part of the "Total" column are the actual numbers of those who hound employment.

Fig.4 Knowledge and Skills that Enterprises Expected to Middle Class Skilled workers

Knowledge of quality control, finding and solving problems, and diagnosis of machine & equip.

Knowledge of related operation examination & measurement process planning of manufacture knowledge of electronics knowledge of automatic control.

Source: Human Resource Development Center in Case of Scale Co.



while all girls have been required to take one class of Industial Arts.

In upper secondary schools, technical course students have been required to take fundamental subjects such as "Fundamentals of Industry" (Kogyo-Kiso), "Mathematics in Technology" (Kogyo-Suri) and "Practice" (Jissyu). These subjects aimed to improve funamental knowledge and skills of students, and to accommodate teaching materials and method to various students.

(4) Introduction of "Fundamentals of Information" (Joho-kiso) into Lower Secondary Schools and "Independent Project Study" (Kadai-Kenkyu) into Upper Secondary Schools.

Concerning the circumstances of educational reform, the Economic Planning Agency of Japan published a long term economic forecast in which the 21st century would be characterized as internationalization, a high percentage of elderly persons and slower economic growth.

A research was conducted by the Human Resource Development Centre about employer's expectation of their worker's capability. The result of this research can be seen in Fig 4.

M.O.E. revised the Course of Study in order to cope with problems brought on as work places were changing, economic circumstances were being internationalized and lifelong integrated learning became commonplace in the Japanese society. Concerning the revision of Industrial Arts curriculum in lower secondary school education, M.O.E introduced computer literacy education. The inclusion of computer literacy in Gijutsu-ka is an important part of Japan's plan to faciliate, systematically, computer education in public schools. M.O.E identified three major aspects of computer education: computer Literacy, computer assisted instruction (CAI), and computer managed instruction (CMI). Of these three major areas, the first area which is related with computer literacy is included in "Gijutsu-ka" at the secondary level. From the viewpoint of equal opportunity for boys and girls in education M.O.E decided that four areas should be required, those are Wood Work, Electronics, Home Life, and Food, while Metal Work, Machinery, Cultivation and

Table 7 Objectives and Contents of "Fundamentals of Information"

Objectives	Contents
Through operation of computer, to help students to understand roles and functions of computers, and to foster capability for use of computers and information.	(1) Structure of Computer a. Fundamental Structure Computer System b. Function of Software (2) Fundamental Operation of a Computer and Programming a. Fundamental Operation of a Computer b. To Understand Function of Program and Programming (3) Application of Computer System a. Application of Information Technology by Use of Software b. Application of Computer System (4) To Understand Roles of a Computer in Daily Life and in Industry

Fundamentals of Information are required elective. According to the investigation by M.O.E in 1991, 76% of all students in lower secondary schools wanted to study Fundamentals of Information. ("Jyoho-kiso") It is a favorite subject area among students, in spite of that, Fundamentals of Information is an elective required subject area.

Each instruction area (1), (2) and (4) takes several hours in total. The first area, computer hardware, covers the function and operation of central processing unit (CPU), input/out-put devices, computer peripherals, and relation between operation of devices and software. Computer software, the second area, deals with the purpose of computer software and fundamentals of computer programming. The third area, application of computer software, is the largest and contains new materials, with a total, of 20 hours of planned instruction. The content includes the operation of word-processing, spread-sheet, database, computer-assisted drafting (CAD), and machine model control by a computer. The forth area, computer and society, contains content in such matters as advantages and disadvantages of computer use in daily life and industries, and the future of computer use. (M.O.E. 1988). An emphasis is put on the use or modification of existing programs, rather than on the creation of new computer programs. The curriculum standard is being designed by M.O.E so that the some computer education can be provided even though teacher use different computers or computer languages. (Stern, S.1989)

In the upper secondary school level, M.O.E revised technology literacy-related subjects in order to aim to foster basic and flexible capability. In general subjects, M.O.E encouraged the use of computers when teachers instruct science, mathematics and so on.

All of vocational course students are required to take new information technology-related subjects concerning their own major course such as Agricultural Infomation Processing, and Home Economic Information Processing. The most remarkable revision concerning technology-related subjects is the introduction of integrated problem-solving subjects, such as "Mechatronics" (Denshi-Kikai denshi: electronics, kikai: machinery) "Applied Mechatronics," and "Independent/Assignment Project Study" (Kadai-Kenkyu).

The reformed structure of technology-related subjects and courses is as follows: Fig 5 (Murata, S.1990). The above-mentioned trend is based on "School-Based Education and Training in Industry" which is one of human resource development policies in Japan.

2 Progress of Teaching Methodology in VOTEC

At the beginning of Industrial Arts education, facilities in most of the schools were in very poor condition. Some of I.A's techers were enthusiastic about developing low cost home-made teaching facilities/materials. Japanese science and technology teachers were much encouraged by the Science Education Programs in the USA, such as PSSC, IPS, and CBA. (Ohtsuka, S.et al.1967)

In the mid 1970's, educational technology spread in science and technology education. Effective visual aids such as video tape and OHP became quite popular in Japan. Experts of educational technology called this method "Multi-Media Instruction", while answer

Table 8 Trainsition of the Number of Sub-course and Subject in Industry C.

Revised Year of C.S.	1951	1956 *a	1960	1970	1978 *b	1989 *c
Sub-courses	—	21	17	21	13	15
Subjects	44	228	156	164	64	74

*a: Diversification of Tech. Curriculum
*b: Introduction of Common Core Technical Subjects.
*c: Introduction of Integtated/Problem Solving Oriented Subjects

Table 9 Summary of Integtated/Problem Solving Oriented Subjects

Objectives	Contents
◎Mechatronics To understand fundamental knowledge and skills related with mechatronics, and to foster capability and attitude for practical use of mechatronics	(1) Outline of Mechatronics Integration of Electronics and Mechanics in Machines /Devices (2) Function of Sensor Principle and Characteristics of Sensor (3) Sensor and Computer A/D Conversion, Logic Circuit and Signal (4) Fundamentals of Actuator Types and Characteristics of Actuator (5) Contorol of Actuators (6) Mehcanics and Power Transmission Devices
◎Independent Project Study To set up industrial projects through problemsolving study, to deepen and integrate of knowledge and skills to foster ability and attitudes for active, creative problem-solving.	(1) Design and Manufacture in Function/Form/Quality/System (2) Investigation/Research on Relation between Industry, Society and Human Being (3) Experiment and Tryout Fundamental Experiment for Design/Practice (4) Practice in Workplace in Industries Comprehensive Integrated Practice (5) Acquisition of professional/Vocational Certification
Examles of Projects: Design and manufacture of robots/remote control model/linear moter car/electric car, Machine control by computer etc.	

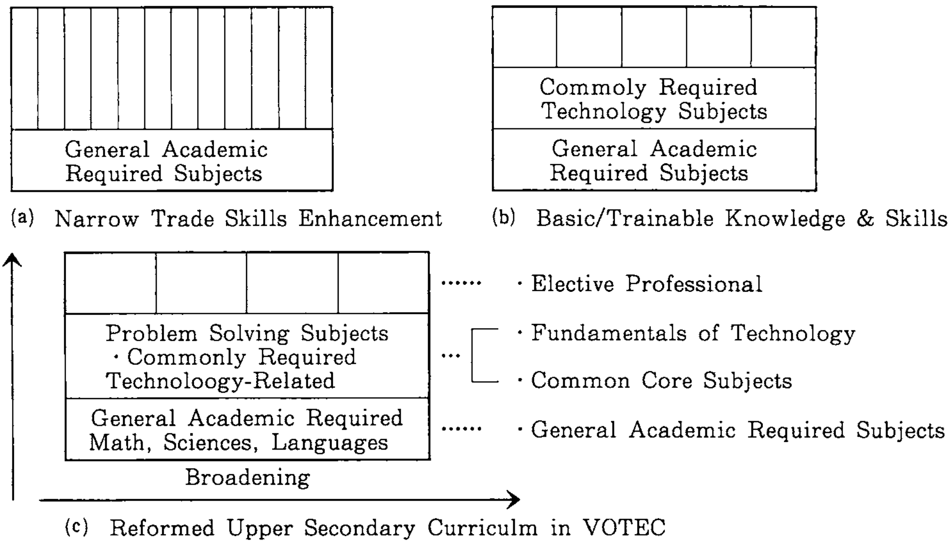


Fig 5 Structure of Technology-related Curriculum in Recent Year in Japan

checker and recorded teaching sheets did'nt become popular in technology education. (K.U.Smith and M.S.Smith, 1980)

The computer instruction in Japan lagged behind developed western countries, however, in recent years, the number of computers have been increasing in secondary schools. (M.O.E A survey on Information Education 1991) Revision of the Course of Study is one of the incentives for CAI/L and CMI in science and technology education. (A.Sakamoto. 1991)

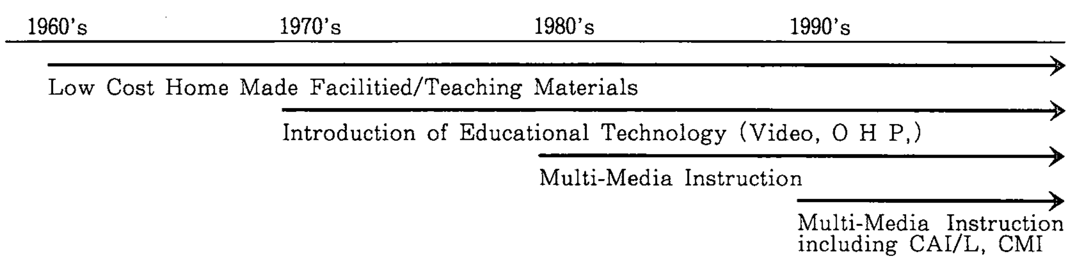
3 Supportive Measures for Technology literacy Education

The implementation of technology literacy education curricula has led to the following suppotive measures:

(1) Facilities and Equipment Support

The Vocational Education Promotion Law was enacted in 1951. The national government was obliged by this law to promote vacational technical education and to encourage local governments to facilitate vocational technical education. Industrial Arts and Voca-

Fig 6 Progress of Teaching Methodology in Technology Education



tional Courses Equipment Standards were promulgated by M.O.E after each curriculum standard set up the minimum requirements of these subject's facilities and euqipments. The national govenment subsidized upper secondary schools. The subsidy amounted to one third of the budget for vocational technical facilities and euqipment in upper secondary schools. Half of the budget for technical facilities equipment in compulsory schools were based on the above-mentioned standard. (MOE. 1980)

(2) Initial and In-service Teacher Training

Initial teacher training took place mainly in the faculty of engineering in national universities, or in the technical education department in national universities. In 1960's technical teachers began to be trained in the Industry Teacher Training Course which was attached to the faculty of engineering. Technical innovation were so rapid that technology/technical teachers were always having to be retrained. After each curriculum standard was revised, MOE planned and implemented in-service training, "Central Training" (Chyuo-Kensshu), and the local authorities of education (LAE, the Board of Education in Japan) also implemented in-service training "Local Training" (Chiho-Kensyu). Central Training trained teacher's consultants, senior/leading teachers. Those trainees eventually became trainers of local in-service teacher training. This process of teacher retrainig played a role in systematic top-down dissemination of the revised standard of curricula. (Murata, S.1985) The budget of in-service teacher training is subsidized by the national and local governments. Concerning the introduction of computer literacy education, currently there are about 16,000 Gijutu-ka teachers that teach in approximately 10,000 schools in 47 districts of Japan. To retrain these teachers and to help them teach computer literacy at new classes is a major undertaking. At the begining of April in 1988, about 160 Gijutsu-ka teachers received full-time training on computer literacy curriculum for two weeks. For more than three years a total of 480 such leading teachers had received retraining. In addition to two week's intensive training, these leading teachers had a personal responsibility for self-study about computers. Each newly trained teacher returned to his/her district and began training other Gijutsu-ka teachers in that area. This peer training began in 1989. The local/district-level retraining continued for four years. Because of this program all the Gijutsu-ka teachers in Japan received retraining in computer literacy. (Stern, S.1988)

(3) Educational Centers for VOTEC

Every prefecture has its Educational Center. Each Educational Center has a department of technology in order to faciliate industry-related education, including information technology. Several major big prefectures have independent institutions such as the Information Technology Education Center or Technical Education Center. These educational institutions have several functions: teacher retraining, development of teaching materials, investigation/research for methodology of education and so on. In order to use the educational budget effectively, educational centers are equipped with expensive facilities for technology education such as large scale computer system, "Machining Center", and so on. Most educational centers are also equipped with school buses for transportation of students and teachers.

(4) Textbook Examination and Subsidization for Compulsory School Textbooks

All textbooks in compulsory schools and most upper secondary schools are compiled and published by private publishing companies, after being examined by MOE. The textbooks in compulsory schools are supplied to students without charge. The purpose of this system is to maintain the quality of the textbooks. (MOE.1963)

(5) Teacher's Allowance for Technical/Agricultural Education

In order to keep the number and quality of industry-related educational teachers, the national and local governments raised teacher's salary by 10% as an allowance.

4 Problems Facing VOTEC

(1) Pressure of Entrance Examination

Industrial Arts/Technical education is regarded seen as a subordinate subject/education. After the high economic growth era, most parents became enthusiastic about sending their children to upper secondary schools and college/universities. In 1950's and 1960's, students had to take all required subjects in entrance examinations, but students and parents complained that there were too many subjects. Because of the complaints, since the 1970's, the number of subjects has been reduced and Industrial Arts, Fine Arts, and Health Education have been excluded from the examinations. In the end of the 1980's, Natural Science and Social Study were also excluded. Industrial Arts ranks as the second favorite subjects of nine required subjects among students. (Murata, S.1985). Being excluded from an entrance examination, Industrial Arts/Technical education is regarded as a subordinate subject by parents and students. They have a tendency to make little of this subject.

(2) Cooperation of Education/Training Institutions

Many countries do not have integrated political measures. Because of the lack of the integration, educational organizations do not fully carry out their plans on human resource development. The following table is a summary which shows how organizations cooperate in education and training in Japan.

(3) Drawbacks Exist in Promulgation of Curriculm Standard

Intervals between revisions are too long to reflect a rapid technological change. Employers expect the standard to be more flexible because there are discrepancies between

Table10 Overview of Education and Training in Japan

	Education	Training
· Administration	Ministry of Education Science, and Culture (M.O.E)	Ministry of Lobour (M.O.E)
· Law	School Education Law	Human Resource Development Law
· National Standard /Plan	Course of Study	Basic Plannig for Human Resource Development (H.R.D)
· Revision Standard	About Each 10 Years	Each 5 Years
· Latest Revision	March, 1989	June, 1991
· Organisation of Consultation	The Ad Hoc Educational Council	
	The Central Council of Edu. The Curriculum Council The Council for Science Edu. and Industrial Edu. The Prefectural Council for S.E and V.E	The Cental Human Resource Development Council The Prefectural H.R.D. Council
· Major Goal	Life long Intergrated Education and Training	
	Self Learning Ability Basic Fundamental Knowlege Skills Trainnable Common Core Ability Universality	Life long Training Occupational Practical Knowledge Skills Speciality

actual society/work site and contents of technology teaching.

(4) Relationship between Maintaining Level of VOTEC and Equal Opportunity

In recent years, shortening of working hours has been a very important labour policy in Japan from the viewpoint of global economy. Five day schooling is also just around the corner, and limiting the total time of schooling is severely. On the other hand, technology education for all students is a common goal in most countries. Women groups complain about sex discrimination in the work place and in education. In order to cope with these problems, MOE revised the Course of Study in technology education and Home Economics education. As a result of the revision of the Course of Study, time allocated to technology education decreased by 50%. The Republic of Korea decided the system of "Choice" between Technology and Home Economics. The Japanese government decided the system of "the Same" regardless of a student's needs. Which is preferable, "Choice" or "the Same" ? (Lee, J.W. 1990)

(5) Lack of Budget for Technology Education and Well Educated/Trained Teachers

"Small is beautiful" is applicable not only to LSI, but also to a slogan of the Japanese governmental budget. This slogan covers a budget for education.

Many well-educated engineers get jobs in big private companies. Only a small part of graduates get engaged in technology education.

Conclusion

Comparing VOTEC in OECD and UNESCO APEID member countries, the similarities are accelerated changing speed in industrial sector and prevalence of industrial technique.

In order to help students to adjust themselves to changing work place, in recent years, the curriculum development of VOTEC has aimed to develope flexible and trainable capability of young people.

It is very important for students to study not only general-academic subjects or vocational subjects, but also common core technology-related subjects such as computer science, mathematics in technology, information technology-related subjects, and independent study projects. (Murata, S. 1991, 1992)

In the industrial sector, many employers are gradually train their employees through work experiences in shops/branches as the "On the Job Training (OJT)". (Koike, K. and Inoki, T. 1988)

The plan/program for VOTEC should be deliberated/created from long-, medium- and short-term point view, and at the same time, associate/cooperate with educational and indusrtial sectors should be carried out.

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